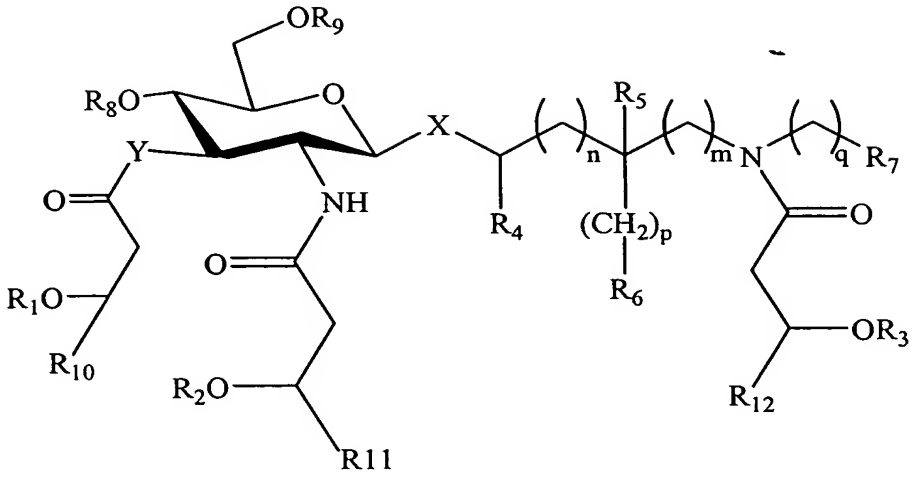
CLAIMS

What is claimed is:

1. A compound having the formula (I):



(I)

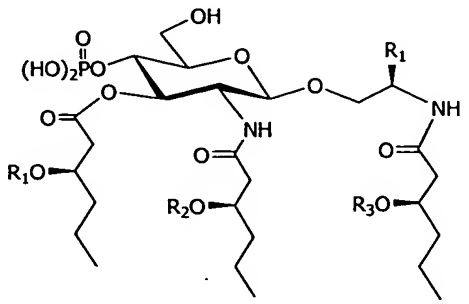
wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n, m, p and q are integers from 0 to 6; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 and R_5 are the same or different and are selected from the group consisting of H and methyl; R_6 and R_7 are the same or different and are selected from the group consisting of H, hydroxy, alkoxy, phosphono, phosphonooxy, sulfo, sulfooxy, amino, mercapto, cyano, nitro, formyl and carboxy, and esters and amides thereof; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.

2. A compound according to claim 1 wherein X and Y are oxygen, R_1, R_2 and R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted saturated aliphatic groups having from 3 to 9 carbon atoms.

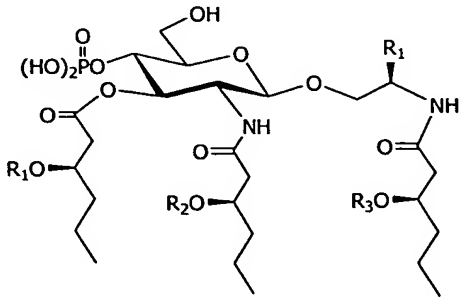
3 . A compound according to claim 2 wherein R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted aliphatic groups having from 3 to 7 carbon atoms.

4. A compound according to claim 1 having the formula



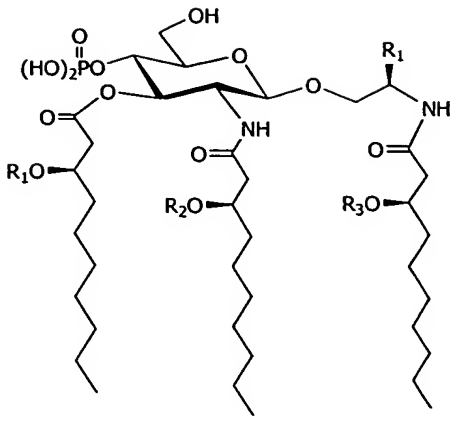
wherein R_1 is COOH or $CH_2OPO_3H_2$ and R_1, R_2 and R_3 are each C_6 saturated acyl groups.

5. A compound according to claim 1 having the formula



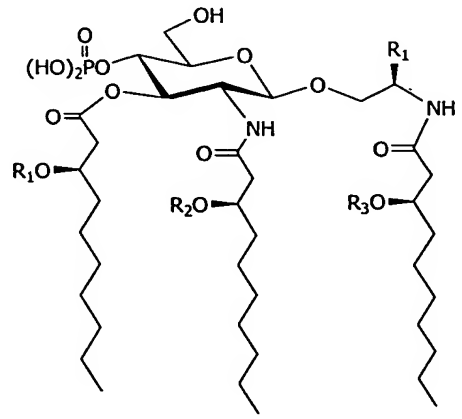
wherein R_1 is COOH or $CH_2OPO_3H_2$ and R_1, R_2 and R_3 are each C_{10} saturated acyl groups.

6. A compound according to claim 1 having the formula:



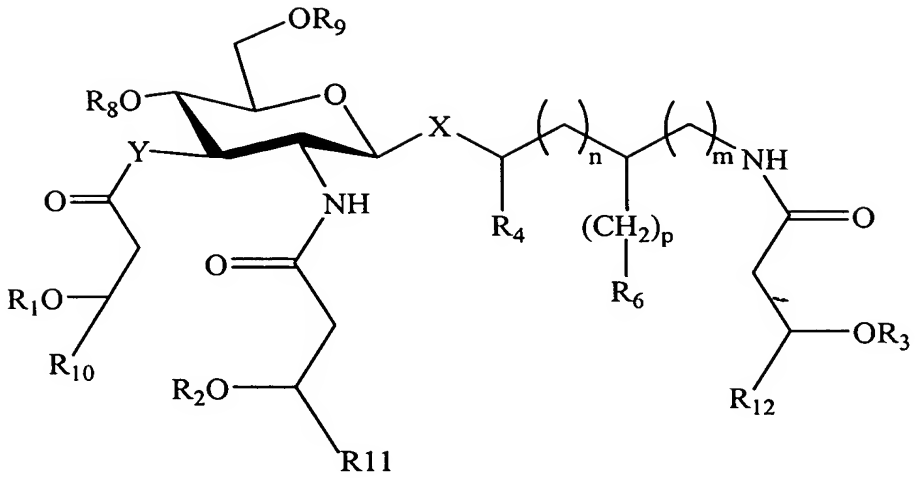
wherein R_1 is COOH or $CH_2OPO_3H_2$ and R_1, R_2 and R_3 are each C_6 saturated acyl groups.

7. A compound according to claim 1 having the formula:



wherein R_1 is COOH or $CH_2OPO_3H_2$ and R_1, R_2 and R_3 are each C_{10} saturated acyl groups.

8. A compound having the formula (II)



(II)

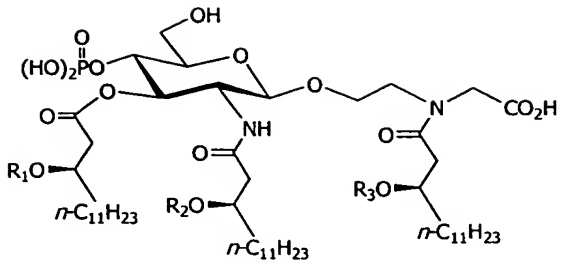
wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.

9. A compound according to claim 8 wherein X and Y are oxygen, R_1, R_2 .and R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted saturated aliphatic groups having from 3 to 9 carbon atoms.

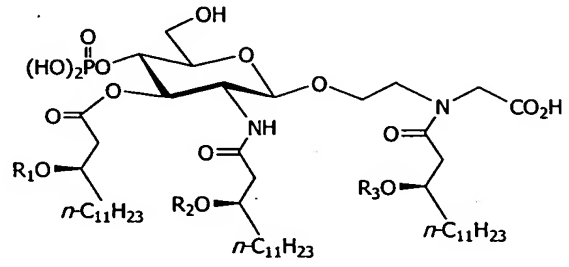
10. A compound according to claim 9 wherein R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted aliphatic groups having from 3 to 7 carbon atoms.

11. A compound according to claim 8 having the formula:



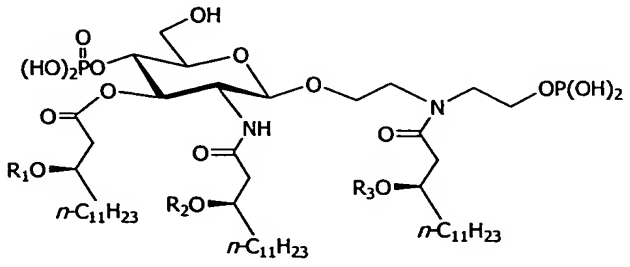
wherein R_1, R_2, and R_3 are each saturated C_6 acyl groups.

12. A compound according to claim 8 having the formula:



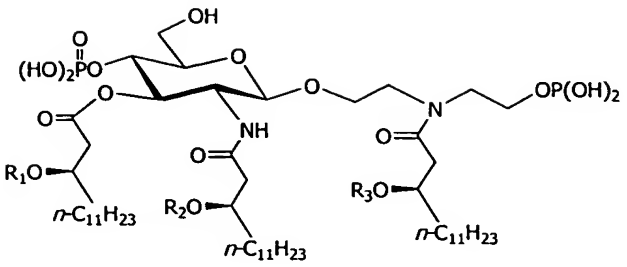
wherein R_1, R_2, and R_3 are each saturated C_{10} acyl groups.

13. A compound according to claim 11 having the formula:



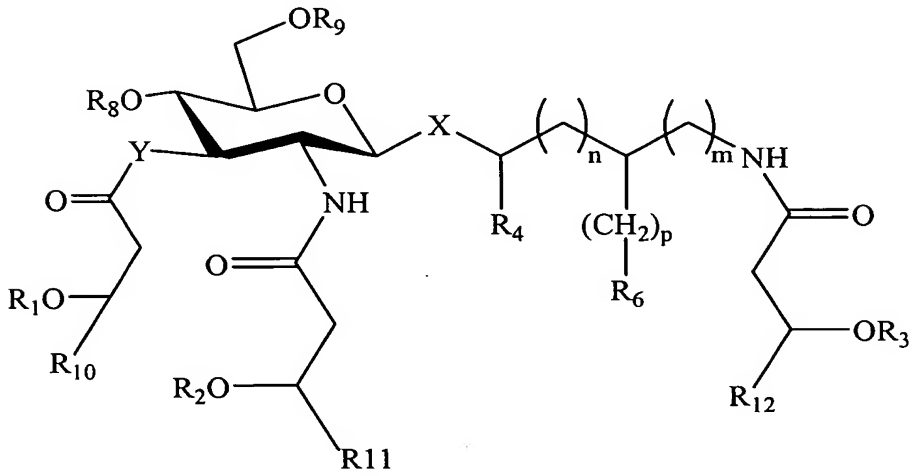
wherein R_1, R_2 and R_3 are each saturated C_6 acyl groups.

14. A compound according to claim 11 having the formula:



wherein R_1, R_2 and R_3 are each saturated C_{10} acyl groups.

15. A compound having the formula (III)



(III)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 11 carbon atoms;

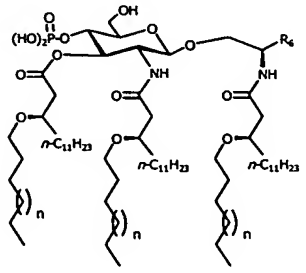
or a pharmaceutically acceptable salt thereof.

16. A compound according to claim 15 wherein X and Y are oxygen, R_1, R_2 and R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10},

R_{11} and R_{12} are independently straight chain unsubstituted saturated aliphatic groups having from 3 to 9 carbon atoms.

17. A compound according to claim 16 wherein R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted aliphatic groups having from 3 to 7 carbon atoms.

18. A compound according to claim 15 having the formula:

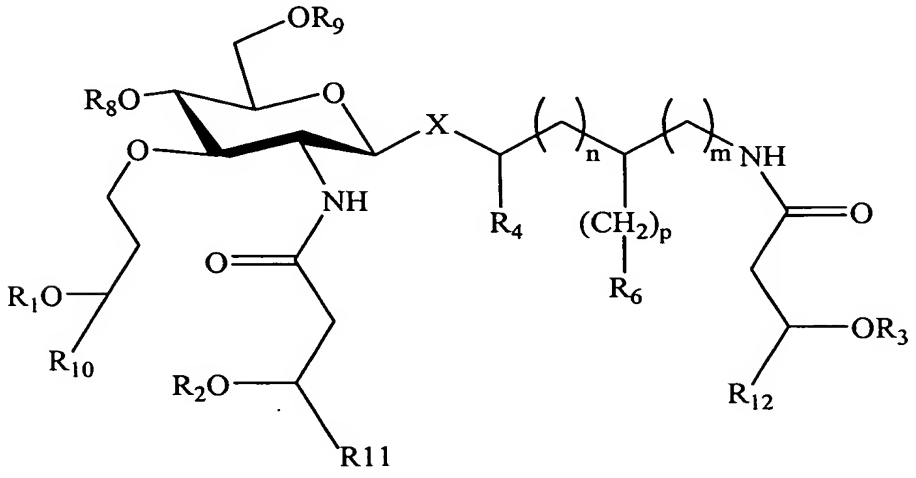


wherein *n* is 1 or 5 and R_6 is COOH or $CH_2OPO_3H_2$.

19. A compound according to claim 18 wherein *n* is 1.

20. A compound according to claim 18 wherein *n* is 5.

21. A compound having the formula (IV):



(IV)

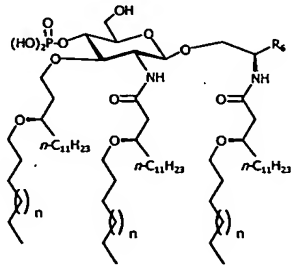
wherein Y is oxygen; X is selected from the group consisting of O and S at the axial or equatorial position; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.

22. A compound according to claim 21 wherein X and Y are oxygen, R_1, R_2 and R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted saturated aliphatic groups having from 3 to 9 carbon atoms

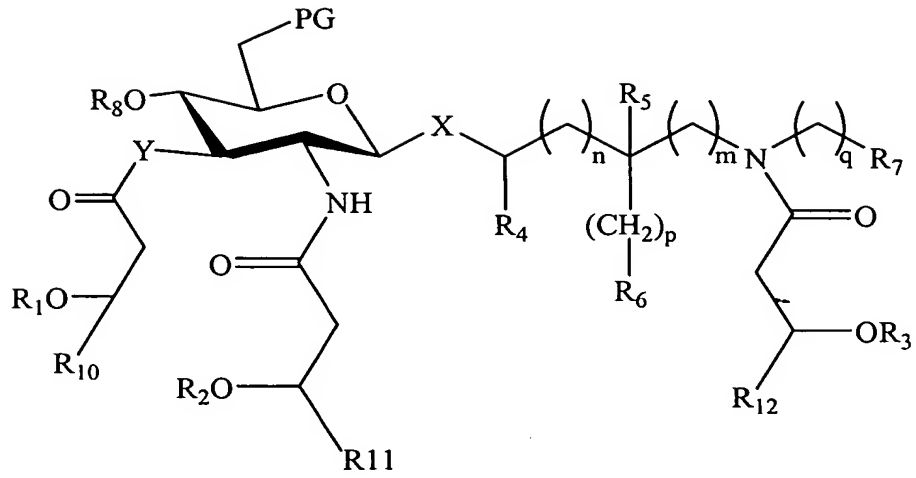
23. A compound according to claim 22 wherein R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted aliphatic groups having from 3 to 7 carbon atoms.

24. A compound according to claim 21 having the formula:



wherein *n* is 1 or 5 and R_6 is COOH or $CH_2OPO_3H_2$.

25. A compound having the formula (V):



(V)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n, m, p and q are integers from 0 to 6; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 and R_5 are the same or different and are selected from the group consisting of H and methyl; R_6 and R_7 are the same or different and are selected from the group consisting of H, hydroxy, alkoxy, phosphono, phosphonooxy, sulfo, sulfooxy, amino, mercapto, cyano, nitro, formyl and carboxy, and esters and amides thereof; R_8 is phosphono; PG represents a hydroxyl protecting group, and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.

26. A compound according to claim 25 wherein X and Y are oxygen, R_1, R_2 and R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted saturated aliphatic groups having from 3 to 9 carbon atoms.

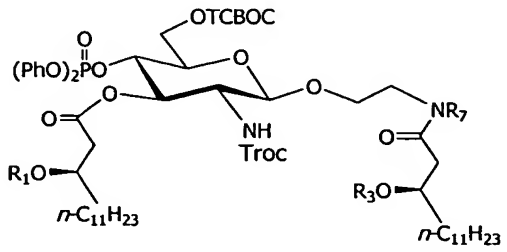
27 A compound according to claim 26 wherein R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted aliphatic groups having from 3 to 7 carbon atoms.

28. A compound according to claim 25 wherein X and Y are oxygen, R_1, R_2 and R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10},

R_{11} and R_{12} are each straight chain unsubstituted saturated aliphatic groups having 11 carbon atoms.

29. A compound according to claim 28 wherein PG represents $-OCH_3$ or F.

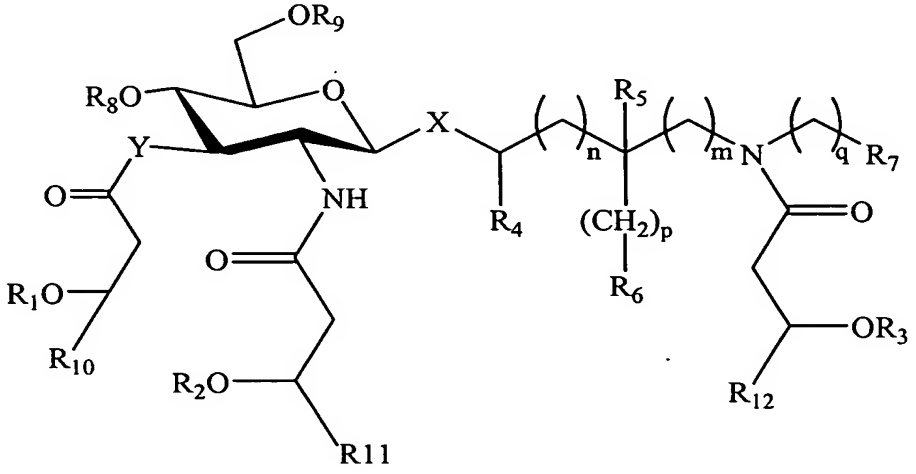
30. A compound having the formula:



wherein TCBOC represents a 2,2,2-trichloro-1,1-dimethylethyl chloroformyl protecting group; Troc represents a 2,2,2-trichloroethoxycarbonyl protecting group, R_1 and R_3 are C_6 or C_{10} saturated aliphatic acyl groups, and R_7 is a protected carboxyl or phosphate group.

31. A pharmaceutical composition of matter comprising

(a) an effective amount of a compound having the formula (I):



(I)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n, m, p and q are integers

from 0 to 6; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 and R_5 are the same or different and are selected from the group consisting of H and methyl; R_6 and R_7 are the same or different and are selected from the group consisting of H, hydroxy, alkoxy, phosphono, phosphonooxy, sulfo, sulfooxy, amino, mercapto, cyano, nitro, formyl and carboxy, and esters and amides thereof; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms; or a pharmaceutically acceptable salt thereof; and

(b) a pharmaceutically acceptable carrier.

32. A composition according to claim 31 wherein X and Y are oxygen, R_1, R_2 and R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted saturated aliphatic groups having from 3 to 9 carbon atoms.

33 . A composition according to claim 32 wherein R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted aliphatic groups having from 3 to 7 carbon atoms.

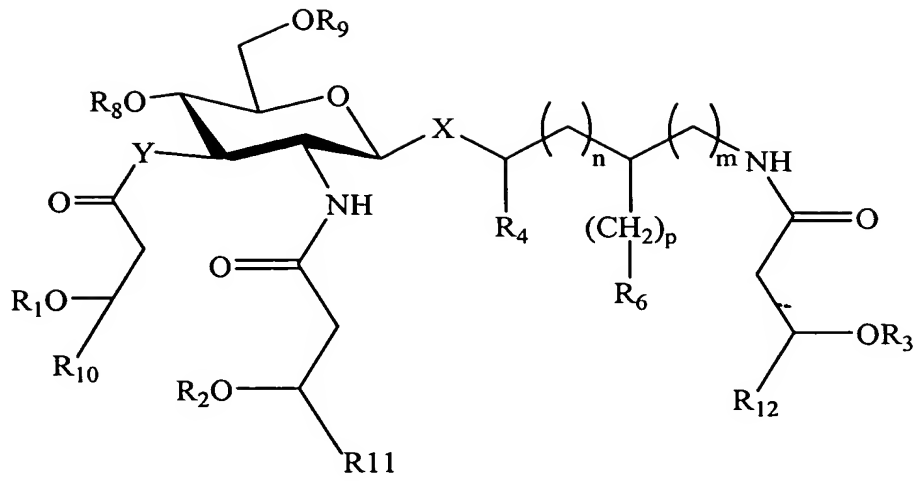
34. A composition according to claim 31 suitable for mucosal administration.

35. A composition according to claim 31 suitable for intranasal administration.

36. A composition according to claim 31 further comprising an antigen, and comprising an adjuvant-effective amount of the compound of formula (I) or salt thereof.

37. A pharmaceutical composition of matter comprising

(a) an effective amount of a compound having the formula (II):



(II)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms; or a pharmaceutically acceptable salt thereof; and

(b) a pharmaceutically acceptable carrier

38. A composition according to claim 37 wherein X and Y are oxygen, R_1, R_2 and R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted saturated aliphatic groups having from 3 to 9 carbon atoms.

39 . A composition according to claim 38 wherein R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted aliphatic groups having from 3 to 7 carbon atoms.

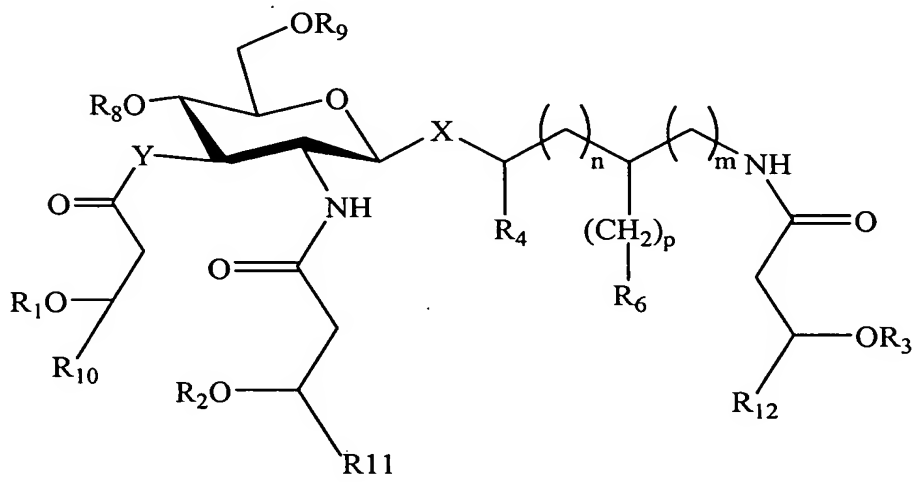
40. A composition according to claim 37 suitable for mucosal administration.

41. A composition according to claim 37 suitable for intranasal administration.

42. A composition according to claim 37 further comprising an antigen, and comprising an adjuvant-effective amount of the compound of formula (II) or salt thereof.

43. A pharmaceutical composition of matter comprising

(a) an effective amount of a compound having the formula (III):



(III)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 11 carbon atoms; or a pharmaceutically acceptable salt thereof; and

(b) a pharmaceutically acceptable carrier.

44 A composition according to claim 43 wherein X and Y are oxygen, R_1, R_2 and R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted saturated aliphatic groups having from 3 to 9 carbon atoms.

45 . A composition according to claim 44 wherein R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted aliphatic groups having from 3 to 7 carbon atoms.

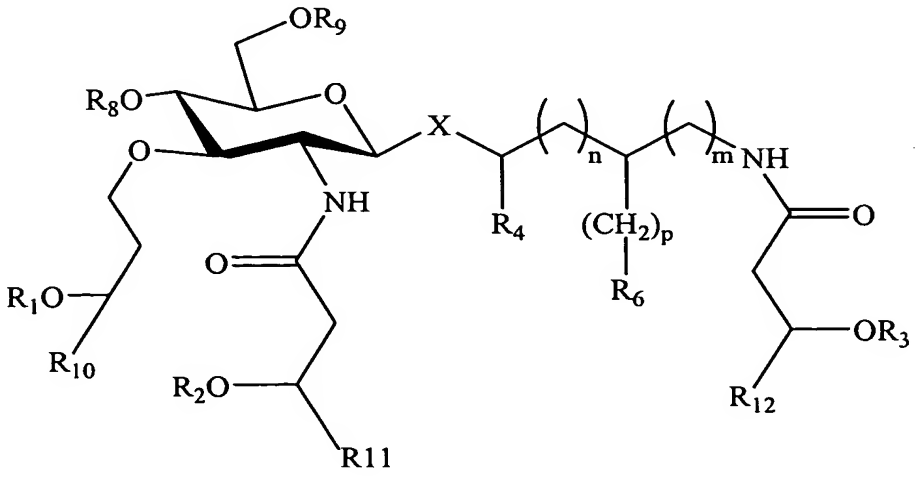
46. A composition according to claim 43 suitable for mucosal administration.

47. A composition according to claim 43 suitable for intranasal administration.

48. A composition according to claim 43 further comprising an antigen, and comprising an adjuvant-effective amount of the compound of formula (II) or salt thereof.

49. A pharmaceutical composition of matter comprising

(a) an effective amount of a compound having the formula (IV):



(IV)

wherein Y is oxygen; X is selected from the group consisting of O and S at the axial or equatorial position; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl

residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms; or a pharmaceutically acceptable salt thereof; and

(b) a pharmaceutically acceptable carrier.

50. A composition according to claim 49 wherein X and Y are oxygen, R_1, R_2 and . R_3 are independently selected from C_6-C_{10} saturated aliphatic acyl groups, and R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted saturated aliphatic groups having from 3 to 9 carbon atoms.

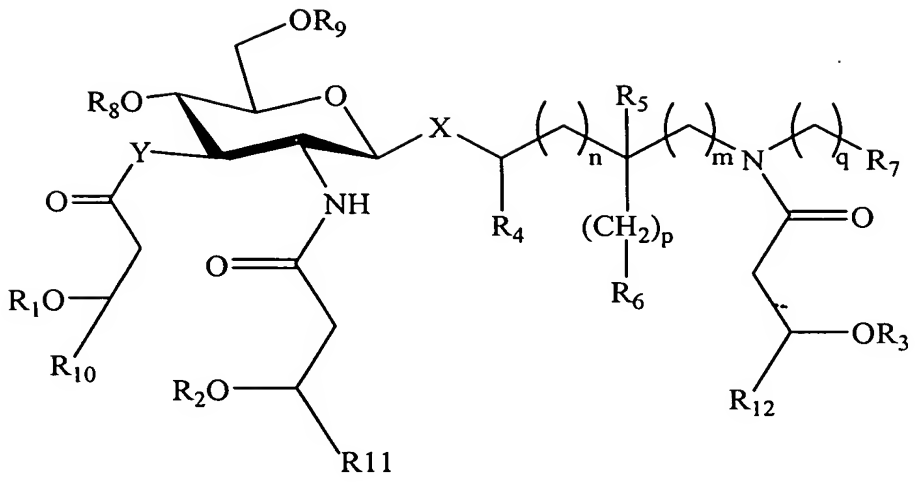
51 . A composition according to claim 50 wherein R_{10}, R_{11} and R_{12} are independently straight chain unsubstituted aliphatic groups having from 3 to 7 carbon atoms.

52. A composition according to claim 49 suitable for mucosal administration.

53. A composition according to claim 49 suitable for intranasal administration.

54. A composition according to claim 49 further comprising an antigen, and comprising an adjuvant-effective amount of the compound of formula (II) or salt thereof.

55. A method for enhancing the immune response of a subject comprising administering to said subject an effective amount of a compound having the formula (I):



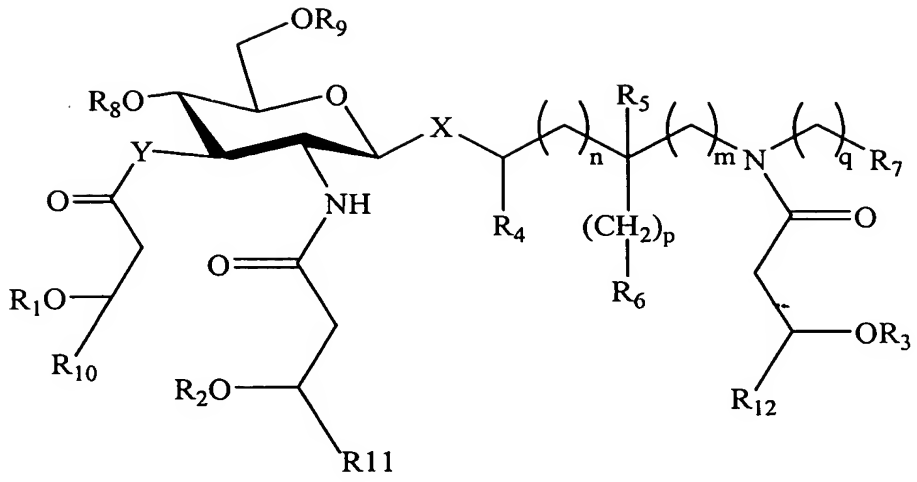
(I)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n, m, p and q are integers from 0 to 6; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 and R_5 are the same or different and are selected from the group consisting of H and methyl; R_6 and R_7 are the same or different and are selected from the group consisting of H, hydroxy, alkoxy, phosphono, phosphonooxy, sulfo, sulfooxy, amino, mercapto, cyano, nitro, formyl and carboxy, and esters and amides thereof; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.

56. A method according to claim 55 further comprising administering an exogenous antigen to said subject.

57. A method for ameliorating or substantially preventing an infectious disease, an autoimmune disease, or an allergic condition in a subject comprising administering to said subject an effective amount of a compound having the formula (I):

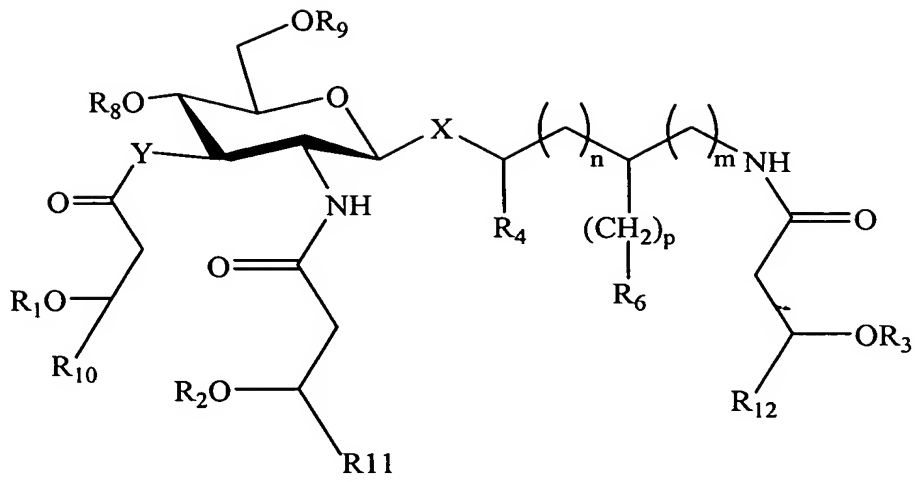


(I)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n, m, p and q are integers from 0 to 6; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 and R_5 are the same or different and are selected from the group consisting of H and methyl; R_6 and R_7 are the same or different and are selected from the group consisting of H, hydroxy, alkoxy, phosphono, phosphonooxy, sulfo, sulfooxy, amino, mercapto, cyano, nitro, formyl and carboxy, and esters and amides thereof; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.

58. A method for enhancing the immune response of a subject comprising administering to said subject an effective amount of a compound having the formula (II):



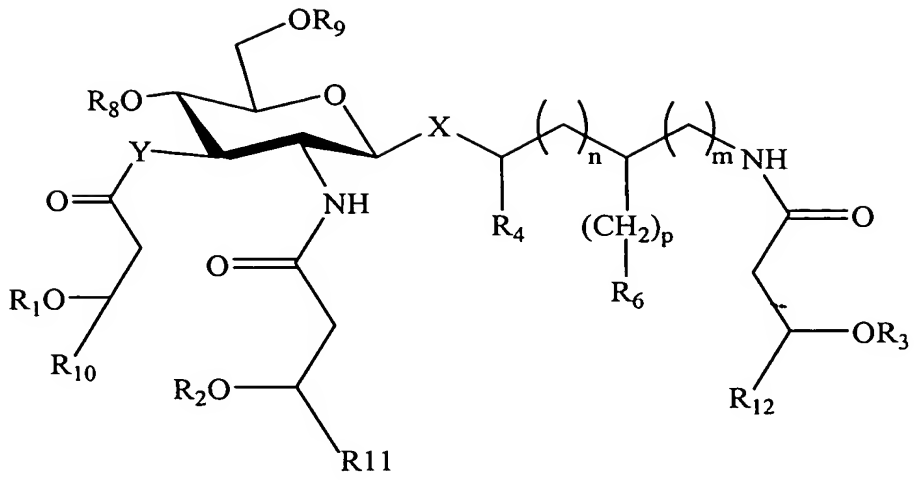
(II)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.

59. A method according to claim 58 further comprising administering an exogenous antigen to said subject.

60. A method for ameliorating or substantially preventing an infectious disease, an autoimmune disease, or an allergic condition in a subject comprising administering to said subject an effective amount of a compound having the formula (II):

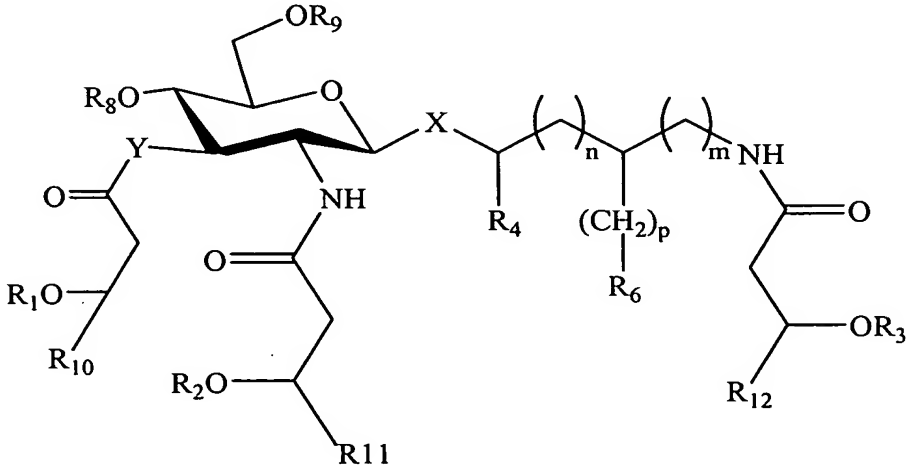


(II)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.

61. A method for enhancing the immune response of a subject comprising administering to said subject an effective amount of a compound having the formula (III):

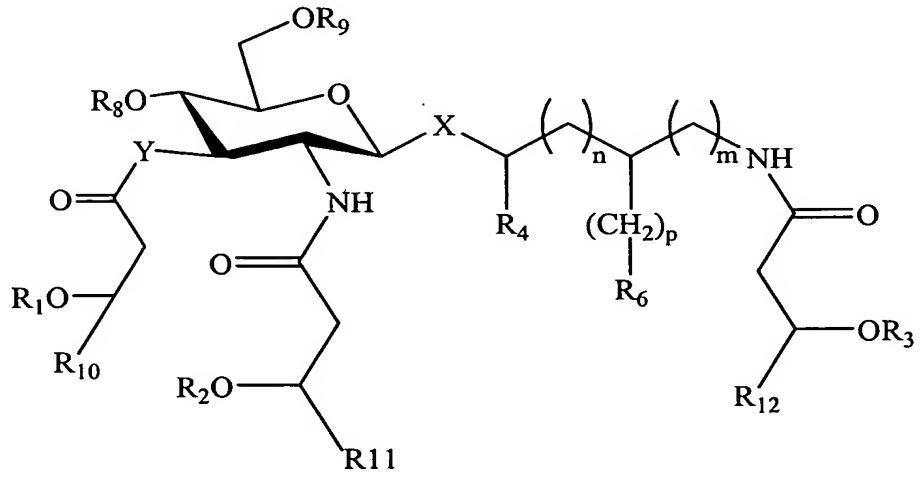


(III)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 11 carbon atoms; or a pharmaceutically acceptable salt thereof.

62. A method according to claim 61 further comprising administering an exogenous antigen to said subject.

63. A method for ameliorating or substantially preventing an infectious disease, an autoimmune disease, or an allergic condition in a subject comprising administering to said subject an effective amount of a compound having the formula (III):

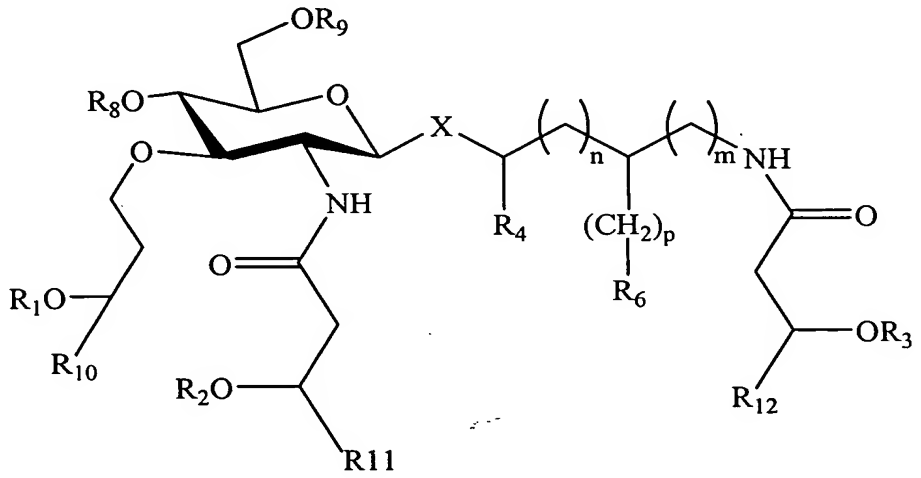


(III)

wherein X is selected from the group consisting of O and S at the axial or equatorial position; Y is selected from the group consisting of O and NH; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group

consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 11 carbon atoms; or a pharmaceutically acceptable salt thereof

64. A method for enhancing the immune response of a subject comprising administering to said subject an effective amount of a compound having the formula (IV):



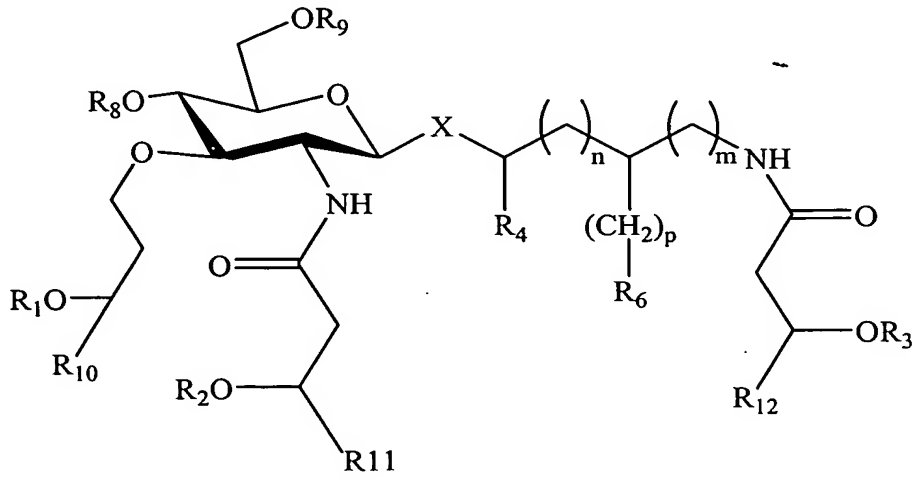
(IV)

wherein Y is oxygen; X is selected from the group consisting of O and S at the axial or equatorial position; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.

65. A method according to claim 64 further comprising administering an exogenous antigen to said subject.

66. A method for ameliorating or substantially preventing an infectious disease, an autoimmune disease, or an allergic condition in a subject comprising administering to said subject an effective amount of a compound having the formula (IV):



(IV)

wherein Y is oxygen; X is selected from the group consisting of O and S at the axial or equatorial position; n and m are 0; R_1, R_2 and R_3 are the same or different and are fatty acyl residues having from 1 to about 20 carbon atoms and where one of R_1, R_2 or R_3 is optionally hydrogen; R_4 is selected from the group consisting of H and methyl; p is 1 and R_6 is COOH or p is 2 and R_6 is OPO_3H_2; R_8 and R_9 are the same or different and are selected from the group consisting of phosphono and H, and at least one of R_8 and R_9 is phosphono; and R_{10}, R_{11} and R_{12} are independently selected from straight chain unsubstituted saturated aliphatic groups having from 1 to 10 carbon atoms;

or a pharmaceutically acceptable salt thereof.